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TACTILE READING

by Hubert Horbach

Observations of and Experiences with Tactile Reading

Part One

Posing the Problem

Complexity of the Visual Reading Process

Survey of Pertinent Research Works

"Often when I let my fingers glide across the string of pearls of braille I have felt a desire in me to learn something about the mysterious forces which, coming from the braille, produce the same effect in the brain centers as does reading by sight."

We find here in the wish of the aulic councillor, Ritter von Chlumetzky, a clear reference to the complexity of every reading process and its psycho-physical character. We con- front in each reading process a twofold, rather heterogeneous activity of the mind which results in the same psychic end effect. We are now directly confronted by the question: To what extent do the ways or processes so different in origin as are visual and tactile reading remain structurally different. --

Do not the means become identical at some point in reaching the same goal? -- Or, in other words, in what ways are the two reading processes different and alike? Modern psychology, especially in the last decade has occupied itself extensively with the visual reading process and has brought to a head significant experimental results. It is therefore natural

to look here in order to clarify the process of tactile reading.

Our formulation of questions gains ground as soon as we abandon the naive conception that reading is essentially a mere act of perception; it is, on the contrary, a complex proceeding, a psychic operation, in which, as Professor Dr. Kutzner points out, characters (signs), chosen according to agreement, are to be retranslated into thoughts. This retranslation, however, does not result directly, but indirectly, via the language. A beginner feels especially how strong the influence and furtherance of this medium (the language) is if he tries to understand the content of a passage in a foreign language without retranslating it into his native tongue. Speech is the first and most natural medium of expression of our thoughts, and consequently, the acoustic memory picture of the word is its chief carrier of meaning. The most direct purpose of sensory comprehension of written characters, which one often signifies as a depot or mill of our thoughts, is accordingly to revive words which then in their turn reproduce a conception of their meaning. That these are the most essential pahses of the reading act is agreed upon by all modern authors who have concernced themselves with the question, save for some terminological differences. These phases, according to Kutzner, are "perception of the word picture, reproduction and influence of the acoustic memory picture of the word and speech motor conception, reproductive and associative influences," or in short, "optical perceptions, reproductions of the speech sounds, reproduction of the meaning." The sense coherency (der Sinn-

zusammenhang), thus, is on no account to be understood as only the final goal, but is an essential factor which enters the reading process, clarifying, supporting it, and facilitating word recognition. In this multiformity the act of touch reading gains significant approximation to the visual reading process. While the first phase, the sensory comprehension of the written characters in visual and tactile reading is basically different (to the disadvantage of tactile reading) the remaining conditions for their proceedings, which lie in the field of psychology and physiology, will be alike and of equal value. This becomes evident in the relatively high standard of the reading ability of the skillful blind, which would remain inexplicable without the co-operation of other factors than only that of identification of each individual character.

The following statements therefore proceed from a survey of research works that deal with the complexity of the visual reading process, and in particular with the areas in which individual factors are operative, and from the results of these we will draw conclusions for tactile reading.

The oldest analytical works about the reading process made the perception of the written characters crucial to the problem because this perception determines all the conditions for the remainder of the process. They neglected the complexity of the process and thus arrived at one-sided interpretations. They attached a far greater significance to what was given optically than it actually was due, and the higher components of the process were undervalued in their effects.

At the center of interest was the question of whether

the written characters should be comprehended successively or simultaneously. First it was approached from the physiological standpoint, and one arrived at the following interpretation: The Fovea centralis, the place of the most clear vision, is very small so that a simultaneous perception of a great number of letters is impossible. The individual letters, rather, have to pass the macula lutea in a successive order as the eye wanders along the word configuration in order to achieve comprehension. Reading occurs successively and results in a summation of the individual letters. Upon this view Grasley built a method of spelling. Contrary to this view, Catell came up with the experimentally proven fact that one could comprehend only four or five letters from a a group of meaninglessly ordered letters, while one could comprehend 12 to 15 of them in the same time if the letters were in a meaningful relationship. He concluded from this that one comprehends meaningful words as a whole. This controversy has aroused a lively exchange of thoughts since the turn of the century. Promoters and opponents of the Catell theory seek to explain their views by way of far reaching statements, and to prove them by way of experimental research.

It is not intended, however, in this work to give a chronological and perfect account of this controversy. Of this wealth of material only those thoughts and problems that are or could become important to theories of touch reading should be emphasized especially those that shed light on the individual factors of the reading process that are valuable for our purposes.

Because of a thoughtful work of Erdmann-Dodge, the problem has once again become significant. In an experimentally exact

analysis it was ascertained that the eye, when reading, does not move continuously but rather in jumps and carries out the act of seeing only in a state of rest. In a tenth of a second the eye may perceive 4 to 5 letters of a meaningless combination; however it may perceive 16 to 25 letters of a meaningful letter combination. The place of the clearest vision is too small to absorb at the same time the picture of so many letters. It is substantially smaller than the area of the simultaneous comprehension of visual impressions for which Erdmann introduces the term reading area; this comprises, besides the place of clearest vision, also a zone of unclear vision which surrounds the first one. Thus it became possible to explain a simultaneous comprehension, the details of which could not all achieve a clear degree of comprehension, and for the total interpretation of which is needed, in addition to sensory comprehension, yet other factors of a psychic nature. For the substratum of such a comprehension Erdmann coined the expression total form (Gesamtform) and distinguished in the course of his analysis a two-fold total form, a coarser one and a finer one. He then ascertained that a simultaneous comprehension which embraces little more than a grey spot of a certain lenght and size often can rouse a word configuration; but he further noticed that such a total form is not always capable of calling forth the right word; for that it still would require a clear recognition of complexes of dominating letters. These are apperceived, and the word parts still missing are assimilated. This theory was developed further by Dr. Kutzner and defined more exactly. He gives the following definition of the term total form in his "Critical and Experimental Contributions to the Psychology of Reading" which appeared

in 1916: Each word has a certain something that the eye can grasp at a single glance, something by which it can be recognized under otherwise favorable conditions. It is, so to speak, the something New that has come out of the sum of visual signs as does a chord from individual tones. As one chord can be distinguished from another one without one having to necessarily recognize the individual tones, so it should be here. In opposition to the objection that the exclusive evaluation of the impression of the total form or, as he calls it, the form quality could lead to the wrong assimilation, he points out that this objection has its justification only in tachistoscopical reading but that tachistoscopical reading is performed under quite different conditions than is ordinary reading because it excludes the aids coming from the higher psychic areas, or at least, confines them sharply. Kutzner then distinguishes a subjective form quality from the objective one, and he proves in numerous experiments that the purely subjective form quality too is capable of letting a word emerge and leading it to the right assimilation with the co-operation of the aids given in ordinary reading. What is given optically is not so dominating a factor in the reading process as is usually assumed; it is not the sole factor but only the inducive substratum of the reading process. Words can be recognized before the deatails are ever identifed; accuracy in reading on no account depends solely on the visual impression, and a recognition of all details is therefore no necessary criterion for what is denoted as "reading."

Of special interest are some statments by subjects who participated in the experiments of Prof. Kutzner. Prof. Dr. Erismann

says of the reading process as a word is exposed:
"A visual impression arises which rouses an associative complement for the total word; then follows the impression that the complement fits into the word configuration; then, perhaps a visual elucidation of the impression which has already disappeared occurs, and it can be pretended that one has seen everything."

Prof. Dr. Stoerring points out:
"The word came primary, not secondary, directly forced upon by the reality of perception; I cannot give details."

In opposition to several objections to the previously mentioned operating form (Wirkungsform) of the form quality (Gestaltqualitaet) Dr. Kutzner states: That the form quality does not lead to the right goal under all circumstances, for example, without aids cannot be rated as proof against the form quality. Nor is the fact that the course of reading is of necessity successive even if the possibility of successive reading, which is uncontested, has been proven. But if under the conditions of ordinary reading the word configuration arises by way of the coarser form quality, without following the letters individually, it means a great savings of psycho-physical energy, according to the general laws of the economy of the mind.

Kutzner's view is confirmed in lucid statements from the tachoscopic experiments concerning "Reading from Successive Presentation by W. Stein" which was published in 1928. The author proceeds on the following view: Form quality is of great importance in reading; however, it cannot be the sole cause, otherwise it would be impossible to read without its influence. The Form quality is a co-cause, the importance of which will become

clear if its influence is systematically eliminated from reading. From the modification that occurs and from the size of the modification one will be able to clearly measure the influence of the form quality in reading. Stein created reading conditions for such an examination, in which simultaneity was excluded through a successive presentation of individual letters. Because the external conditions of the reading process came closer to those of tactile reading than to those of ordinary reading by sight, we will come back to this experiment in part two of this work. At this point we are interested only in the results of the experiment which are as follows: "Unfortunately it was not possible to create absolutely pure cases in these examinations because the effect of the form quality could not be completely isolated in a successive presentation and in many cases it was recognized in a secondary way by the subjects. Despite this it was possible to definitely establish the following: If on the basis of the successive presentation the effect of the form quality is reduced a prolongation of the time of exposure and much larger number of presentations become necessary before a word arises at all and before the correct word is read. If the attention is focused alternately on different parts of the word, it proves most favorable to direct it toward the beginning of the word. It necessitates the least number of presentations because the impression of a form quality is here achieved first.

When a word is presented backwards, that is, with its order reversed, no disturbance enters the reading and all subjects declare that they experienced the form quality primarily. If

some middle letters are left out in the exposed words, the form quality is destroyed and only if the gaps are filled again is the form quality established and are the subjects able to read. But if the stimulus is itself moving, its action on the retina is temporarily reduced; the relationship of the written character to the background is changed, and it does not come to a physiological simultaneity; no desire arises to apply any word. It is thus unmistakably proven that 1) the form quality is highly important and 2) what is given optically acts only as an inducive factor in reading, putting other psychic factors into action."

Kern, in his work "Is Our Reading Method Correct?" also agrees with Kutzner's views that simultaneity and not succession predominate in the perception of written characters, and that the form quality has the greatest influence upon the course of the reading process. His great methodical interest leads him soon to the question of whether subjective differences appear so distinctly in the proceedings of perception that one can speak of different types of reading as various authors emphasize. Thus Messmer recognizes a subjective and an objective reading type; Grossard speaks of an active and a more receptive behavior of reading persons confronting what is given optically; Wundt distinguishes apperceiving and assimilating reading; the apperceiving reader turns on the excitement of the complexes at the disposal of the consciousness only after having attained the distinctness of the stimulating complexes, and the assimilating reader even before then. The former resembles the objective type and the latter the subjective type. Wiegand does not attach a great deal of importance to the distinctions between types since the differences

of subjective factors are hardly noticable in ordinary reading and can appear chiefly only in tachistoscopical reading.

The great efficiency which is attributed to form quality in the preceding presentation has often been doubted and even completely denied by other authors. Messmer says: "The total optic configuration presents itself to the attention through simultaneous perception. It can suffice for an apperception; on the other hand the individual letters that dominate the optic picture enter consciousness successively. The individual acts of consciousness succeed themselves with such speed that the end effect has the appearance of simultaneity. Consequently, two factors co-operate upon recognition of a word configuration: the total optic character and the dominating letters. The first operates simultaneously, and the latter, successively."

Zeitler departs further from the theory of the form quality in his statement; he points out: "Simultaneity is valid in reading only as far as the extent of a dominating complex. We lined together dominating letters and complexes in acts of consciousness that succeed one another. Even if reading may result extremely rapidly it no less remains successive. In an exclusive use of small letters sightless subjects recognize no dominating elements and make many wrong assimilations. Thus the form quality alone, according to Zeitler has little efficiency, and the reading act comprises the following acts: "Familiar syllables are assimilated, that is, they are simultaneously apperceived; less familiar components are spelled, that is, they are ascertained in their written state (Zeichenbestand)."

Wiegand appears an opponent of the form-effect (Gestaltwirkungs theorie) theory. He says: "If only the coarser total form is

perceptible, conceptions of words become reproduced in some subjects, but the subjects know that it all is a matter of guessing. The possible act of recognition arises only on the basis of recognized detail." Schumann also adheres strongly to a theory of succession in the reading process and finds in his experiments that only with very familiar words no succession is noticed. Reliable subjects declare that in other cases they have passed successively through the recognized letters. Schumann, thereupon, contests the effect of the form quality and thinks it necessary for the sensory stimuli of all letters to co-operate.

In his article "Experimental Contributions to the Psychology of Reading" Wagner also appears an opponent of the form-quality theory. He attacks Erdmann's demonstrations that undoubtedly a co-operation of the form quality exists in fast reading because it is impossible to mentally comprehend enough letters that are needed for the recognition of a word in such a short span of time. Wagner declares that this contention does not correspond to facts, and bases his adverse point of view on his findings that the words that have been read agree with the exposed ones much less according to the total form than according to a more or less great number of letters. Since the preceding objections are based almost without exception upon experiments at the tachistoscope and neglect completely the great departures which distinguish tachistocopic reading from ordinary reading they naturally suffer a strong loss of conclusive force for ordinary reading.

In the preceding treatment of the reading process we are confronted with uniformity of opinion only in the fact that the sensory comprehension of the written characters is not the sole factor of the reading process but only the inducive one; the

opinions, however, part on the c urse of this inducive function. In this state of affairs, placing our goal demands first, to recognize the evident advantages of a form-effect and a comprehension of the totality and to examine every possibility of their evaluation and further to compare and pay attention to all other possibilities that are named in the various theories, particularly if they approximate the course of tactile reading. Secondly, the unanimity with which all authors agree concerning the interference of other factors that are beyond the sensory function in the reading process leads us to direct our special attention to the statements on their effectiveness.

"Reading is an internal speaking," says Stein; "Writing and language are the means of expressing thought." And Prof. Kutzner calls reading a retranslation of traditional written characters into thoughts. ~~But as writing is an indirect means of expression of our thoughts, the retranslation of traditional written characters into thoughts.~~ But as writing is an indirect means of expression of our thoughts, the retranslation operates via language which approaches our world of thought much more directly than does writing. The acoustic-motor word picture carries a meaning, the content of thought. These sound pictures are,according to their internal and external nature, no more a sum of individual sounds than is the written picture one of letters. They are more; they have a structure, a form that is conditioned by the rhythm, pitch, pauses, and a certain influence of the totality of the word upon the indivudual sound. (Kern) R. Werner expresses himself similarily in his experimental psychological analysis of the structure of the word picture by saying that every internal relation influences the character of the individual reading part, differentiates it, combines it to a higher unity, and cmpletes its specific structure. The word picture emerges as a form; consequently, the course of the acoustic-motor process cannot be regarded as depending on a summation of innervations. The number of words that can be called to life by optical sensory elements becomes strongly limited among each other by the far branched out associations of the sound pictures and the speech motor innervations; thus the effort to recognize these words is guided more aimfully. Upon these data rests the great importance which all expert literature attributes to the acoustic memory picture of the word and to the speech-motor conceptions of the reading process, as is elucidated further by the following quotation: "On the basis of characteristic forms and secondary criteria a familiar sound picture emerges which occasionally

has in its train a momentary emergence of the final picture." A word is not read on the basis of its detailed optic components; it is read by us as soon as the acoustic-motor word picture reminds us of it. But, if despite this, the words that were read assume a distinctness as if we had remained with them longer and had read them in a q uite differnet way, it has to do with the fact that the sound picture reproduces the optic picture and thus calls forth a visual distinctness which, however, depends only in a very small part on reproduced elements of sensations but rather on reproduced sensations. The acoustic memory picture is so closely associated with the visual total picture that a phonic analysis becomes unnecessary. Such sound pictures are more frequent than is mostly assumed, and a fugitively appearing sound picture remaining in the background of consciousness can withdraw itself from self perception." (Kutzner)

"It is deceptive to assume that the distinctness of the sound picture stems only from the optic influence. Rather the reproduction of the facial picture by the acoustic picture is responsible for it." (Messmer) "It is natural that the total form releases the acoustic motor word picture, to which the visual one associates itself." (Stein) "The first important result is the reproduction of the acoustic-motor word picture as soon as lines of character s are seen and the subjects are conscious of not having verified any letter." (Wiegand) Zeitler is of an opinion similar to Wiegand because he fully admits the importance of the acoustic-memory pictures for reading, but he traces their release not back to the total form but to the determinate letters. Kutzner further emphasizes that the dissolution of the words into syllables and into a variegated mixture of these syllables the influence of the speech motor association is repealed and a considerable increase of the reading time occurs which, of course, would have to be traced back partly to a disturbance of a sense-coheren œ (Zinnzusammenhang)

Thus the acoustic aids enter the reading process as considerable supporters and mediate the step into the far branched out associative sense conherences with the partly sensually comprehended and partly reproduced optic word picture; they become in the reading process supporting aids of such power and consequence that they are acknowledged next to the sensory fucntion as factors of equal value. With their existence, the act of perception of writing occurs in a considerably different form, and their influence places the ordinary reading in its value of efficiency and existence

far beyond the tachistoscopic reading. The optic data recede considerably in importance after the entrance of this factor." The trained reader does not get hod of the material by way of a toilsome successive synthesis of the individual letters. He operates with higher units which at least for the consciousness are comprehended simultaneously as a somehow formed totality or as a group belonging together; for the mind is made up so as to put parts together to form a whole. Reading is something more than a perception of letter forms, something considerably different than a comprehension of meaningless combinations. It is the comprehension of a logical whole and the sense relationship has influence upon the perception of the individual and under its influence the individual is not a part but a member of the whole." (Kern)

Kutzner proves how this influence affects the comprehension of the individual letters and how it operates. He indicates in a special series of experiments how the possibilities and the frequency of an indentification of a letter change according to its position in the word, and he gains in these facts an insight into the "densely branched out net of the reprodcutive and associative elements of a word." In these differentiations of the detail in the written picture we find a parallel to the corresponding establishment in the sound picture by R. Werner.

The previously mentioned co-operation of the acoustic and psychic forces is given in nature. One can therefore never exclude it completely. It is to be isolated in tachistoscopic reading from the sensory function by way of the shortest expository time, it never completely succeeds. This explains why the declaration of the decision of the subjects often happens a considerable time after the time used for exposition. If the reproductive influences could not develop sufficiently during the exposition, they do it afterwards. The functionings of these forces are unconscious and thus they mostly evade self observance. We find an illustration of their way of functioning in the two following examples:

If a subject has taken in a rather unclear total picture of a word in tachistoscopic reading, she is offered an abundance od interpretative possibilities that are not limited by any principle. But in ordinary reading the sense content draws at once narrow limits. The decision is considerably easier to make.

Kutzner refutes the statement made by Wiegand that it is possible only with a limited number of deeply inprinted word picture to read or to guess them on the basis of the form quality. He says: "What in this case the earlier

imprinting performs, the sense coherence does in ordinary reading."

The size and the importance of these psychic influences can be proven numerically.

The reading times used with the child learning to read according to Lautier's method are at the beginning considerably shorter of the individual letters than of words. But with a progressive development of the reading skill this relationship soon changes. Kutzner proves in his tabloids on the analysis of the ordinary reading that the reading times of individual letters, of syllables in a variegated order, or of texts that are separated by intervals between letters or between syllables, distinguish themsleves clearly, but all are larger than the reading times of compact texts. Thus in respective experiments the amount of reading time used for 200 indivudual letters equals the time used for reading 1218 letters in a meaningful text.

The most deliberate consequence of the intervention of the higher components in the reading process is the diminuation of the importance of the optic data. In the same amount as the influences of the first rises the worth of the visual facts declines, and the statement -- "Reading is not recognition in the sense of an identification of all details." -- remains uncontradicted in the battle of opinion, and Kutzner can conclude: "In visual reading the form quality and the sense coherence will suffice for a correct meaning.

PART TWO
The Act of Touch Reading and its Components

A review of the literature of touch reading lets the impression arise that one has paid less attention in the respective treatments to the complexity of the reading process and more to the specific acts of the comprehension of the written characters. As an off-set to this, the results of the research on the course of the visual reading process demand that we as well accommodate to the multiformity of the reading process in touch reading in a meaningful manner. There is no reason to limit the complexity of the process, the effective participation of the higher acoustic and psychic factors or even to question it. Of course, it was sort of natural to attribute an indreased interest to the first phase of the process because of its functional peculiarity; but henceforth it should not be overlooked that the sensual comprehension of the character is only the first phase of the process, its release, so to speak, but it is not at all the total complex.

Though tactile reading is different and more difficult in the first phase than is visual reading, the forms of operation of the higher components are equal in terms of "the universal conditions of psycho-physical happenings in man, and their effect will be the same in both tactile and visual reading. Our comparative observations therefore have to be related to all essential moments of the development of the reading process: comprehension of the characters, influence of the language (acoustic picture, acoustic-motor word picture) and the sense attribute (reproductive, assimilative influences).

From this point of view we will consider the first physical-physiological part of the process, the perception of the characters chiefly in its task to release the functions of the higher factors. The deviation in the execution of this task from the form of operation in visual reading is caused subjectively and objectively.

A subjective difficulty exists in the way the sense of touch functions and the following opinions prevail about its specific value: The theory of Heller, based on the findings of the physiological-psychological research by Wundt, ascribes a way of functioning to the external organs of the sense of touch which basically rests upon synthesis. This way of functioning compels sensory comprehension in successive order of those individual parts of an object of perception that are within reach of the peripheric organs and to lead the sensations that are thereby mediated to the higher centers. As an offset to this Dr. Petzelt places in his "concentration power of the blind" the sensory function beneath a higher psychic directive and says: "A task is given to the touching as well as to the seeing and the solution of it means understanding. If something is to be found out by way of touching, the task-like behavior is tied to this something to evaluate all stimuli that come from this something as elements of a whole. This state of affairs is the same in seeing as in touching."

Basic difficulties for the ability to know therefore do not exist when there is a lack of light. Of course, technical difficulties exist in the acquisition of knowledge. Those two modalities, the seeing and the touching, are delimited for each other through a structural difference of the acquisition of knowledge. In the process of touching I need to experience my body in order to acquire a recognition of space, while optic impressions exhibit experiences of space even without fulfillment of these conditions.

Thus an increased specific difficulty in the comprehension of spacial forms, in our case, the comprehension of characters by way of the tactile

sense as apposed to the visual sense is acknowledged in both theories.

An objective restraint of the reading process lies in the characteristic form of Braille. If in ordinary writing a lack of middle, upper, and lower lengths, that is, a too great similarity of the size of the letters cuts off the influence of a form quality or blocks it, the even greater similarity of the braille characters will be much less able to give the multiplicity of word pictures a strongly marked indivudual structure. For that the spacial extent of braille draws tight limits for a total comprehension, and the so essential influence of the color difference between the writing and the background can be replaced only slightly by a differentiation of the qualities of touch that exist here.

Despite such significant restraints touch reading can be very successful.. The tactile reader achieves absolute surety and a relatively great skill. Tactile reading makes nearly the complete literature of mankind accessible to the blind and makes it possible for him to make himself a valid part in the treatment of scientific, cultural, and literary problems without any seeing aid. Such successes cannot be based upon a spelling kind of reading that depends on an identification of every detail. They can become realized only through a co-operation of various factors which in its regular (~~lawful~~) order achieves an effect which does not simply correspond to the sum of the factors, but, according to Wundt's synthesis, to which pecularities are adhered that are not explainable from the individual conponents.

Even if we cannot penetrate into the dimensions in depth of such psychic happenings so that we are able to separate the rates of effectiveness of the individual factors as accurately and sharply deliminating as is demanded, for example, for putting together parts of an instrument or for the substratas of a chemical compound, the observations of external symptoms of the touch reading process and comparisons of the conditions of its course with those of the visual reading are able to come closer to a relevant judgement of problems that were raised. The center (focus) of gravity of our observations and following statements thus is to be extended upon the effect that is shared by the higher components and is to seek to emphasize their great importance for the reading process. Before this, however, meaningful attention must be paid also to the performance of the sensory function.

Our work is divided into two parts:

A) The sensory function, theoretically, experimentally;

B) The higher components, theoretically, experimentally.

A) The Sensory Function

Bürklen, supported by the basic theories of Simon and Dr. Theo. Heller and the earlier works of Kunz, Czermak, Hocheisen, Javalm and Cyperek, gives comprehensive, exact, and purposeful observations and experiences about the functioning of the sensory activity which is placed so strangely in touching and the difficulties that are founded in it. These observations and experiences condense to a systematic doctrine of the touch which was completed by Grasemann. In connection with this we will first of all summarize the observations and experiences of the sensory fucntion that appeared in our experiments, and we will try to evaluate them.

Many times the question of the simultaneity or the succession of the comprehension of the characters stood in the center of interest in the respective treatments. Since these terms experience two different interpretations according to contents and extent, they are to be distinguished from now on.

No formal definition of the terms in question is given in Prof. Dr. Kutzner's "Critical and Experimental contributions to the Psychology of Reading." In his statements as well as in those of the authors named by him the terms of a sumultaneous comprehension seems to be clearly signified as one of the comprehension of a totality, of the form quality, of that individual word picture which is distinguished from all other ones because of a certain something which presents itself directly to the eye. The simultaneity distinguishes itself considerably from the succession because the latter one comprises a number of individual comprehensions and only the summation of them presents the word picture. In this matter the question of a delimitation of the concept of simultaneity according to physical measures of time is not important. -- Compare page ___.

According to Petzelt a pointed stimulus as a border between past and future happenings is a hypothetical, unexpanded something, thus an absurdity. There is no simultaneous stimulus; such a one could not be delimited from successive stimuli; a separation of succession and simultaneity is impossible. In an arrangement of objective stimuli into that which has already been experienced an act of contraction is completed, a meeting of past and future in one unity. Dr. Petzelt calls this unity the stipulating function of everything psychic, the present. All impressions in this experience that is under the stipulation of the present are together in one form, at the same time, in order according to importance, and not distracted according to

an objective systematic arrangement of time. To each task-like act corresponds a specific formation level. The number of the acts stands at the service of the formation.

While the two earlier views show a basic difference in their structure, in the interpretation of our results of touch reading they arrive at the same goal: "The releasing of the acoustic and psychic aids through elements of sensation, either through subjective form quality or through dominating complexes of letters."

"The impressions that have been pulled together in the present for a uniform image (structure), the becoming one thing of past and future through the function of the " show unanimously the great importance of the psychic activity in the visual and tactile reading process.

Our observations about the course of the sensory function in tactile reading first start with a reference by Burklen that the course of the reading act in untrained and in trained reading is not only gradual but also essentially different. In untrained reading we discover strange movements and convulsions of the fingertips which are examined thoroughly by Heller and which have been named touching movements (Tastbewegungen) in tactile reading. Burklen emphasizes the following statements by Javal: " It often does not suffice when the fingers only press upon the dots; the blind person rather has to glide back and forth across the dots. This movement must neither be too fast nor too slow." This fact excludes a simultaneous comprehension and even the comprehension of one letter is successive. But the trained reader is never, or only rarely conscious of such movements, while an observer who can see only notices that the reading finger glides quickly and ~~carelessly~~ calmly across the letters. Burklen's concluding statements, "The dots of a character are not comprehended individually, but the stimuli which stream into the nervous system at the touch of the sign flow together in a psycho-physical blending process..." and..."the individual character is sumultaneously comprehended" are thus correct. There could have developed doubts about this because the Braille characters consist of several dots of which each exercises its stimulus upon a separate place of the peripheric organs. One can rightly question: Do these stimulating effects happen completely simultaneously or do temporary intervals, if only very few, occur; does the direction to the central organ always occur simultaneously or are these stimuli somehow centrally collected?

We find for our question an analogous and very interesting case in an experiment by Stein. He lets the letters of a word run past a little window in the background in the quickest order possible. He wants to enforce a successive comprehension, but despite all this the subjects declare to have comprehended the word in its totality and not to have been disturbed by the reversed order of the letters and not even to have noticed it. Stein concludes that a central union of the letters to the word picture has taken place and he calls it a physiological simultaneity. Thus also the objectively separate stimulating effects will flow together in our case, or, as Dr. Petzelt says, can be comprehended as elements of a whole.

A second question that has been worked on variously in the doctrine of tactile reading applies to the functioning and efficiency of the sensitive powers of the of the sensual organ of the skin. It is understandable if we first determine the position and the size of the reading area, i.e., of that place of the fingertips where the characters are actually touched and to examine whether this place turns out to be similar to the fovea centralis, a place of the most distinct sensation. Our experiment A 1 will deal with this.

Further on it is pointed out in the theory of tactile reading that also other sensory sensations, particularly internal tactile sensations, participate in touch reading besides the pressure sensations of the skin. Bürklen refers to the following statements by Czermak concerning this question:"Although the spatial sense is made sufficiently by nature to satisfy the demands of reading by itself, the blind do not fully use the extensive sensation of distinction of the skin for it. They engage particularly the sensitivity of the joint which is the basis for kinesthesis in reading." In my correlation calculations which were to examine the influence kinesthesis has upon the spacial recognition of the blind we find in a confrontation of the unit of kinesthesis with the efficiency in reading a correlation coefficient of 0.35 while in a comparison of the same with the efficiency of manual work we get one of 0.68 and with results from examinations on form recognition and orientation such of 0.73, 0.75, 0.82, and 0.85. This effect kinesthesis has on reading will not be of too great an importance: the correlation coefficient between reading and general intelligence, however, is with 0.66 already a significant reference for the greater value of psychic components in reading.

From those records that are still left from earlier experiments let us conclude that the influence of the sensitivity of the skin to stimuli cannot have too decisive effects. Unfortunately the remainder of these notes do not suffice for an orderly correlation determination. The influence of the space is, in my opinion, limited to the determination of the size of the Braille letters and cannot be correlated with the results of the reading act.

It, however, should not be denied in the course of these limited remarks that there is already in the area of sensory function in touch reading a complexity such that already at this point a co-operation of several factors does not represent a mere summation of their individual performances.

The objective difficulty in the act of touch reading, as is hinted at already, is founded in the peculiarity of Braille. Even though the invention of Braille adapted itself in such an inspiring manner to the functional possibilities of the sense of touch that in advance it put into practice the experimental results of Wundt which came later, it becomes at least questionable according to present ideas whether it is able to offer the sense of touch functional supply that can be compared with the promoting effect of the form quality in visual reading. Experiment A2 will compare the degrees of difficulty of both reading types in a confrontation of visual Braille reading and ordinary visual reading.

The corresponding experiments by Buerklen are very important in an evaluation of the easier or more difficult recognition of the individual letters. He presented each letter-form 600 times to his subjects and has judged the degree of difficulty of the individual forms according to the frequency of their recognition. This statement will undoubtedly be important in learning to read. The figures, however, are gained from tachistoscopic examinations.

But since the conditions of the reading process in tachistoscopic reading are different from those in ordinary reading, we, naturally, want to examine whether and in how far the different degree of the recognition of the letters becomes significant with a trained reader in a normal reading procedure. Our experiment A3 will evaluate this.

As is emphasized already, we perceive of the comprehension of the individual sign as a totality comprehension. This still leaves the comprehension of the word picture unexplained. At any rate, there is no compulsion to spell and merely to line the letters together. We understand already from daily experience that the speed which we can also achieve in tactile reading cannot be the product of a summation of letters. Therefore,

we can say together with Dr. Kutzner:
We have still other aids at our command, before we are dependent on the individual letters.The essence of these aids lies in the factthat through the production of elements of sensation by way of objective stimulating effects the process at once becomes psychic and the function of the sense meaning becomes effective. Therefore, in tactile reading as in visual reading a minimum of sensory data which are rather meaningless in themselves have to exist and which release the functioning of higher components and can reproduce word pictures of great clarity through them. At any rate a speed can be achieved thus which approximates strongly the speed of normal visual reading. Experiment A4 will establish the quickest possible comprehension of individual letters of a combination of two letters and of short familiar syllables.

EXPERIMENTAL PART

4 groups of subjects participate in the experiments.

I. 6 persons of the faculty of the School of the Blind at Dueren, able to see.

II. 6 blind persons who are occupied at Dueren

III. 12 students at the School of the Blind at Dueren from the year1923

IV. 12 students at the School of the Blind at Dueren from the year 1950.

Those subjects named under II, III And IV have no optic aids or memory pictures at their disposal. In order to be short the groups will be named with the numbers that were mentioned before. We will use only the average figures instead of the individual figures of a group for conclusions and comparisons. The comparitive unit for the determination of the amount of reading time is the time needed for one character in each reading: total duration of the reading divided by the number of the characters. Where the reading material has been read in two different forms or with two different purposes in mind a meantime of one week was inserted every time.

EXPERIMENT A 1

12 blind students
was conducted with group III in 1923. The arrangements of aids that had been created at that time as well as the reading materials and partly the records with the results have fallen victim to the war. Therefore the following statements are mostly reconstructed from memory with the help of rediscovered figures.
The arrangement used consisted for the most part of a two-armed lever,

the right arm of which carried at its tip an interchangeable metal Braille letter. In lifting the arm of the lever the letter fell into place in an opening which was in a plate above the lever. The opening was of the size of one braille sign, and was filled in by a letter coming from below. The moving of the lever arms was induced by weights which when falling down pressed the left lever arm down. Different weights caused different speeds of the moving of the levers and, consequently, different durations of the touching of the letters with the reading finger that could be measured.

The subject was asked to press the fingertip on an ink pad over which was spread green color and then to place the fingertip on the plate in such a way that the place with which the subject thought that it could read best would excactly hit the opening. The letter's tips were colored red. Immediately after the experiment the reader pressed his finger on a white sheet of paper and thus picture of the fingertip appeared very clearly in green color and the letter in it in red color and the position of the reading spot was clearly visible. The fingerprints that we have left indicate clearly that the same subject in 6 experiments that were conducted at different times always hit the same position of the reading area but that interindividually a greater difference existed between these positions.

The letter touched the reading fingers in 1/25, 1/20, 1/12, 1/8, 1/5, 1/4 of a second. The percentage of positive results in the reading experiments with increasing times of exposure amounted to 52, 50, 59, 70, 82, 89% with subject N, to 20, 25, 37, 55, 76, 87% with subject B, to 0, 71, 79, 86, 80, 93% with subject Be; these figures were in the arithmetic mean : 39, 50, 56, 71, 77, 89%.

The uneven rise of these results from the shortest to the longest presentation strikes us. With subject N the percentage moved from 52-89%, with subject D from 20-87%, with subject B from 71-93%. The arithmetic mean rose 11% from the first to the second step, 5% from the second to the third, 15% from the third to the fourth, 6% from the fourth to the fifth and 12% to the last step. It rose 50% from the first to the last step. As the later experiments show the two shortest times occur only in rare cases in ordinary reading.

In order to examine if the reading place chosen by the subjects distinguishes itself from the neighboring regions of the fingertip in its efficiency the subject was askedto put each a place to the right , to the left of the reading areaas well as the place between the reading area and the fingernail or the last joint of the finger on the reading space. The positive results of these reading trials which amount to 71% in the reading

area, 19% in front of it(right at the fingernail), 70% to the right, and 75% to the left , and 85% behind the reading area prove that all regions of the fingertip that can reach the letter comfortably are of nearly equal value in their reading performance with the exception of the place that reaches the fingernail. Thus the differences in the position of the reading area is less a matter of anatomic causes than of individual habits, but which do not necessitate correction because of their completely equality in an evaluation.

EXPERIMENT A 2

was conducted with group I. (6 sighted) Having corrected a lot of papers in braille enabled the subjects to do justice to such a strange task. They read in ordinary writing as well as in braille:

1. a simple narrative (800 letters),
2. a paragraph of the world picture (Weltbild) of the natural scientist by Schneider (744letters),
3. 50 technical terms from chemistry and astronomy (551 letters).

As an exception we will cite an individual accomplishment in our comparison in order to critically examine the purely objective difficulty which is to be examined here; namely that of the fastest visual reader, a librarian,who has a rare maximum of training in visual braille reading.The use of time rises from ordinary reading to braille reading

	in average	in maximum performance
with material I	143%	33%
" " II	167%	60%
" " III	183%	112%

The extra use of time on account of increased difficulties in the content rises within ordinary writing

from I to II	41%	42%
" II " III	76%	45%
" I " III	150%	108%
within braille		
from I to II	56%	72%
" II " III	86%	93%
" I " III	191%	232%

The increase from ordinary writing to braille amounts at best to 33% in visual reading and in a very unfavourable case rises to 183%.In my opinion the extreme limits are marked through these figures that can occur in the visual comprehension of braille.For the tactile comprehension compare experiment B 4. The greater difficulty caused by the contents operates proportionally within

Reading Times a) reading aloud of the letters b) reading in a soft voice of the letters c) aloud as short hand signs d) in meaningful words e) in meaningless words	1. Basic Forms Subject group II a) 0.42 sec. b) 0.34 " c) 0.43 " d) 0.27 " e) 0.35 " +.09	Subject Group IV 0.48 sec. 0.33 " 0.51 " 0.25 " 0.33 "	2.09 - .35
Comparison between			Average
a and d	0.42--0.27=0.15=35%	0.48--0.25=0.23=48%	$\frac{35+48}{2}$ = 41.5%
a and e	0.42--0.35=0.07=16%	0.48--0.33=0.15=31%	$\frac{16+32}{2}$ = 23.5%
b and d	0.34--0.27=0.07=20%	0.33--0.25=0.08=24%	$\frac{20+24}{2}$ = 22%
a and b	0.42--0.34=0.08=19%	0.48--0.33=0.15=31%	$\frac{19+31}{2}$ = 25%
	2. Easier Group by Bürklen +.02		2.06 - .34
a	0.47 sec.	0.47 sec.	
b	0.30 "	0.32 "	
d	0.25 "	0.25 "	
Comparison between			
a and d	0.47--0.25=0.22=46%	0.47--0.25=0.22=46%	46%
b and d	0.30--0.25=0.05=16%	0.32--0.25=0.07=21%	$\frac{16+21}{2}$ = 18.5%
a and b	0.47--0.30=0.17=36%	0.47--0.32=0.15=32%	$\frac{36+32}{2}$ = 34%
	3. More difficult Group +.03		2.87 - .48
a	0.68 sec.	0.75 sec.	
b	0.46 "	0.43 "	
d	0.28 "	0.27 "	
Comparison between			
a and d	0.68--0.28=0.40=59%	0.75--0.27=0.48=64%	$\frac{59+64}{2}$ = 61.5%
b and d	0.46--0.28=0.18=39%	0.43--0.27=0.16=37%	$\frac{39+37}{2}$ = 38%
a and b	0.68--0.46=0.22=32%	0.75--0.43=0.32=42%	$\frac{32+42}{2}$ = 37%

readings of ordinary writing and braille, for braille in a higher numerical plane.

The extremely high rate of the increase from reading material 2 to 3 and even more from 1 to 3 is a consequence of the fact that the third material brings the conditions of ordinary reading off course because it excludes the influences of the higher components, a functioning of the sense meaning, and forces the identification of nearly every letter. The size of the modification in the reading course indicates the amount of the influence of the left out factors.*)

*)The question of whether braille can offer quickly, and clearly recognizable and distinguishable form qualities to a reading eye is by no subject denied. The opinions about the possible extent of a totality comprehension differ from each other. They usually claim from 6-8 signs. For a more exact determination we need a further, special examination.

EXPERIMENT A 3

was conducted with 1 blind 12 blind students groups II and IV. Buerklen's order of letters is thereby divided into halfs. The first group comrises the forms that were recognized in 600 presentations more than 300 times and the second group those forms that remained below 300. The letters of each group were given at first a individual letters in variegated order in altogether 170 signs and later in meaningful words. Both lines of words consisted only of letters of the respective groups. In the same way it was proceeded with the ten basic forms of the alphabet in order to find out whether the limiting of the letter forms to a narrow space of four dots would be of influence. To this group also meaningless combinations were presented. The following list surveys the results.

see next page:

Since this experiment exceeds already in its results the area of the sensory function, a further discussion will follow in experiment B 1.

EXPRIMENT A 4

was conducted with 12 blind students group IV. The characters to be examened are written on so called shorthand rollers of the shorthand machine by Pichte. They run across a reading place which is tightly attached below a table and are put in motion by the winding up of the roller of the shorthand machine. Each stripe contains three signs which are put in equal distances from each other and in a distance from the beginning of the stripe that is adapted exacly to the movement. Each sign takes up the thirtie$h part of the stripe which runs below the table. The subject places his fingers on the tightly

framed reading place so that the reading stripe can pass without stopping and the subject can recognize the dots. The winding up of the stripe is checked by the stop-watch. If it takes two seconds, each sign runs for 0.066 seconds below the finger. In three minutes rotatation time the time for running through is 0.100 seconds, in 4 seconds it is 0.133 seconds, and in 5 seconds it is 0.166 seconds.

Stripes 1 and 2 have letters with upper lenghts, stripes 3 and 4 letters of the easier group, 5 and 6 of the more difficult group, 7 and 8 easier combinations of two letters, 9 and 10 two letters in a more difficult combination, 11 and 12 particularly difficult combinations, 13 and 14 familiar syllables of 3 signs each. Each stripe was presented first in the shortest of the times mentioned and if not all signs had been recognized it was presented in the next one and continuing until all signs had been recognized.

In order to make possible a short survey of the results the following times of exposure, beginning with the shortest one, will be presented with roman numerals, the pairs of stripes will be presented with latin capitals, and the numbers of the subjects that recognized completely all signs in the corresponding time of exposure will be presented with arabic ciphers.

	A	B	C	D	E	F	G	Sum Total
.066 I	6	9	3	0	1	2	1	22
.100 II	6	3	5	5	5	2	4	30
.133 III			4	1	2	1	5	13
.166 IV				4	4	4	0	12
V				2	0	3	2	7
	12	12	12	12	12	12	12	84

Some individual results:

One subject read 13 times in I, 1 time in II

One subject read 12 times in I, 2 times in II

One subject read 6 times in I, 8 times in II

One subject read 4 times in I, 10 times in II

One subject read 3 times in I, 2 times in II, 7 times in III,

Four subjects rose up to IV

Three up to V

The quick, calm, and sure way of recognition lets us believe that a total comprehension takes place for certain with the first stripes. With the letters

of the more difficult group and even more with the combinations of two letters a recognition was often difficult or impossible, particularly when there was a danger that the dots of the second row of the first letters could combine themselves with the dots of the first line of the second letter to a new letter form, like ⠛ for example. Often the behaviour and the tactile movements of the subjects clearly let us see the searching and the grouping of the dots. This phenomenon disappeared with the reading of the familiar syllables of three signs each. The course of this process is a welcome opportunity to illustrate the reading process: the touching finger recognizes a characteristic which may be a still unclear idea of the form and the size of the syllable, a subjective form quality which may be the beginning letter and the number of the other letters or other, similar complexes; these elements of sensation evoke the sound picture of the syllable or their meaning. The reproduction of the syllable is so distinct that it is read with certainty and each subject is convinced to have clearly recognized every letter.

Without being perceived the border between purely sensory operation and the release of higher forces which is effected by it is hereby crossed. The precess takes place under the co-operation of the acoustic as well as the assimilating and apperceiving aids. Higher occurrences that are beyond sensory comprehension become extremely significant.

B) The Higher Components

In this second phase of the reading process the lack of the visual power is no more of direct significance and the now starting higher factors are the same in kind and value for both the blind and seeing people.

Because of reasons we easily can perceive we can say of those aids that come from the acoustic area that their promoting influence is no smaller with blind people than it is with seeing ones.The acoustic impressions are for the blind those sense datas that they achieve without any restraint and in the most pleasant way possible.They are taken in with specific feelings of delight and are woven into the far reaching net of the areas of association. Phonic units which probably remain unnoticed with a seeing person achieve great importance for the inner life of the blind. Maurice de la Sizeranne in his " Psychology of the blind woman" speaks of an " auditive horizon". He describes how this one is formed in the blind in a much more far reaching manner and how much more versatile it is in them than it is in seeing persons. This " auditive horizon" also shows its significance for the blind in many individual experiences which appears strange to the seeing person. Because of their wealth of associations the tendency to reproduce the sound pictures

becomes more lively. With this increase a rise of the tendency of the total inervation to produce speech motor word pictures is connected. There is no doubt that the blind have at a maximum influences of acoustic quality at their disposal which are so significant to the reading process.

Even more essential than the influence of the acoustic aids is those of the assimilating and apperceiving forces. It is the goal, " the task" of each reader not to comprehend certain forms and letter forms but to comprehend the meaning of which these signs are the symbols; this is also the motivation of people of all ages and with a different education to read. An 18 year old subject expresses this thought very clearly by saying:" I never paid attention to the procedures of the reading process but instead gave all my attention to the reading material".

We find a more theoretical explanation of the equality of these forces in blind and seeing persons in the statements made by Dr. A. Kremer in his " Logical placing of the blind into mankind". He says: " The blind belongs to the family of man as does every other individual. From that standpoint he is something general. But he succumbs to the universally valid conditions of mankind in all areas of his psychic, physical, and psychophysical being, of his becoming, and of his debit, in all spheres of his experience, in all regions of his wants and actions. Except for the eye he possesses all physical and mental organs and powers. He obtains a universal, human outlook from this alliance and mutual relationship with all mankind. Human society allows him, as it does on each of its members, a status of individuality which also allows the blind to equally participate in the objectivity of everything mental.

The sensory function mediates lucid moments; knowledge, the sense coherence which is comprehended by way of relations, the meaning , all are illucid as products of psychic acts. A recognition of relations thus cannot be solely a matter of sense data. The idea of relation is the center of the psychic activity and influences decisively the result of the psychic happening and also determines the structure of knowledge that is uniforrm to all. This uniform structure of knowledge as a relation complex is invariably valid for the blind because he is a human being. Therefore, the blind must after having "mentally digested" everything new arrange it within his mind;he has to be able to understand this new even though it was presented him in words or sounds."

An equally directed explanation is taken from Dr. Petzelt's statements: Knowledge is in all its elements of basically the same structure on account of the unity forming function of the present. Ideas that originate optically thus cannot be different from those that originate haptically(by way of touch?)

The modale coloring is not the organization principle for the structure of knowledge; knowledge has relations to all modale spheres, i.e. it can be related to all sense areas."

The psychic forces will be able to operate in the reading process in the same form and with equal success, no matter whether the releasing factors originated tactilely or visually.

EXPERIMENTAL PART

In our demonstrations we will compare the reading times under different reading conditions and will try to recognize from the numerical comparison the co-operation of those factors that have meaning in the respective readings. At first we approach once more the question if and in how far individual signs have to be identified in tactile reading. We compare at first the results of experiment A 3 for this very purpose.

1. The Basic Forms.

Of the greatest significance for our question is the difference of time between those types of readings that are mentioned in the tabloid under "a" and "d"; thus between the reading of individual letters or of letters from meaningful words. The difference of these readings amounts to 35% in group II, to 48% in group IV, and the average to 41,5%. This important difference rests mostly upon the influence of the aids in "d" that stem from the higher components. But we must also consider that the pronouncing of the words takes up quite some time; as we can see, the differences between the reading types "a" and "b", loud and soft reading, amount to 19% in group II and to 31% in group IV. These figures, however, cannot be fully rated because the reading in a soft voice had been a repetition and was done faster, and also because no guarantee was given that all letters actually had been read. If we, however, compare the reading types "b" and " d", the reading of letters in a soft voice and the reading of words aloud, we get figures of the differences which are 20% in group II and 24% in group IV that are undoubtedly completely credited to the higher components, and beyond this still a considerable part of the extra sum of the before mentioned difference between "a" and "d" is added to this account. In the two other types of reading the time needed for the identification of every letter , as was necessary for "a" and "b", seems to be considerably lower.

Other very noteworthy differences are given in a comparison between the reading types "a-d" opposite "a-e". It amounts to 19% in group II and to 17% in group IV and also appears a distinct reference to the influence of the meaning.(Sinngehalts) We will evaluate this last comparison further in expe-

riment B 2.

2. The Group of the 17 Easier Recognizeable Letters

was given in 162 signs of variegated order. The first sign "a" was recognized 425 times in Buerklen's experiments and the last sign "au" 301 times. The results of this experiment were of the same character like those of the basic forms. The difference of these reading times amounted in both groups to 46% in the loud reading of the letters and of the meaningful words, in soft reading to 16% in group II and to 21% in group IV, with an average of 18,5%. Besides this last difference, which is exclusively counted as stemming from the influence of the higher compenents, again the greater difference between "a" and "c" can be partly attributed to the influences mentioned as with the basic forms.

3. With the Group of the 22 More Difficult To Recognize Letters

we do not find a considerable change of the facts but only a gradual one. This group starts with "e" having been recognized 299 times and ends with "y" beeing recognized 203 times. It was given in 170 signs; the differences in loud reading of the letters and of the meaningful words amounted to 59% in group II, to 64% in group IV, with the average of 61,5%, and in soft reading of the letters to 39% in group II, to 37% in group IV, with the average beeing 38%. The reading times for the individual letters increases extremely in both reading types. The reading times of the word readings increases only immaterially. The greater difficulty in the recognition of letter forms recedes considerably in word reading on account of psychic aids. A summation of the averages of the differences between the reading of letters and words in the three groups:

	in loud reading	in soft r. of the letters
basic forms	41,5%	23.5%
easier group	46%	18.5%
more difficult group	61.5%	38%

provides a valuable and sure proof that a universal identification of the letter forms does not either take place in tactile word- or text reading.

The correctness of Buerklen's grouping of the letter forms thus is very much confirmed for the reading of individual letters. Its significance lies mostly in the area of learning how to readfor which it provides very useful references; but its significance goes less for the fluent reading of texts. We compare now the previous results with those of

EXPERIMENT B 1

In this experiment a text was presented in a) a compact form and b) with a seperation of all letters by each one letter width from each other . Group II were given three stories and group IV four stories where the content was easily understood.In the same manner group III read a story of the same diffi-

culty; thus it read a) with and b) without intervals.

The reading times were in a) the compact, b) the interrupted text

with material 1 group II a 0.11 b 0.31
the difference 0.20 seconds = 181% of a, 64% of b
" " of a = increase, of b = saving

with material 1 Group IV a 0.13 b 0.41
the difference 0.28 sec. = 215% of a, 68% of b

with material 2 Group II a 0.07 b 0.28
the difference 0.21 sec = 300% of a, 75% of b

with material 2 Group IV a 0.12 b 0.34
the difference 0.22 sec. = 183% of a, 64% of b

with material 3 Group IV a 0.13 b 0.34
the difference 0.21 sec. = 161% of a, 62% of b

with material 4 Group II a 0.07 b 0.41
the difference 0.34 sec. = 485% of a, 82% of b

with material 4 Group IV. a 0.12 b 0.48
the differnece 0.36 sec. = 300% of a, 75% of b

with material 5 Group III a 0.15 b 0.67
the difference 0.52 sec. = 346% of a, 77% of b
on an average (2171:8) and (567:8) 271% of a, 71% of b.

The conditions of procedure of this experiment differ considerably from those of experiment A 3; first, because the influence of the sense coherence is far greater in a compact text than with disconnected words and second, because the letters that are separated by intervals in a text still are connected by way of contents.

The reading of compact texts saves 62-82% of reading time, on the average 71%. It does not even require a third of the reading time which is needed for the interrupted text or vice versa; The increase of reading time caused by the intervals amounts to 271% of that of the compact text, more than two and a half times. These great differences can again be regarded as nearly exclusively operating by way of the higher factors; the elongation of the reading path for the finger is relatively insignificant as we will show in a later experiment. On an average the differences in this experiment between the reading of the compact and the interrupted text are greater than the differences in experiment A 3 between the reading of letters and individual words. The reading of compact texts results much more quickly than that of compact words, and the reading of interrupted texts is faster than that of individual letters. We therefore confront:

1. The reading time for letters in variegated order on an average= 0.565 seconds
   to the reading of letters in interrupted texts on an average = o.367 "
   There is an average difference of 0.178 seconds = 32%.
2. the reading of compact words 0.36 seconds to the reading of compact texts 0.11
   seconds, the difference here is 0.25 seconds = 69%.

In the last presented story of the "Frogking" the word endings in the first half were also only separated from the next word by one single space. However, in the second half as in the other stories a double interval followed each word ending. The greater difficulty of the text comprehension which is founded in the lack of this double interval was indicated by the fact that 5-6.5% more time were used.

with group III the task of the letter recognition was varied in such a way that the letters of the first 50 words of the story "In the Wet Grave" were presented a) in horizontal and b)in vertical order. Thus besides the reading times also the mere lengths the reading finger had to pass were measured.
The reading times are in b) 284,2, the times used to pass all words 33.8 sec.
The reading times are in a) 38.6, the times used to pass all words 16.7 sec.
the differences are 245.6 17.1 sec.

The mere reading activity demands in b) 284,2--33.8 = 250.4 sec.
The mere reading activity demands in a) 38.6—16.7 = 21.9 sec.
The difference resulting here of 228.5 sec. = 91% of b, 1049% of a.

A second, equally done reading shows the following results:

Reading times:	b) 215.8 sec.,	times used for passing	19 sec.
	a) 37 sec.,	"	14.2 sec.
differences	178.8 sec.,		4.8 sec.

The mere reading activity: 215.8--19 = 196.8 sec. 37--14.2 = 22.8 sec.
The difference of 174 sec. = 88% of b, 763% of a.
An alike experiment which was conducted by Professor Dr. Kutzner with seeing subjects is very interesting at this point. He states in his tabloid I on page 239 that the reading time for the same amount of letters in a text was on an average 70.3 sec. and for letters without connection to a text 90.0 sec; we also find an increase of 28%. With soft, fast reading the reading times amount to 52.3 and 63.9 sec., the increase also amounts to 22% , the corresponding savings amount to 21 and 18%.

In tactile reading the difference between the reading of letters and words stand out more than in visual reading; those previously mentioned differences of 22 and 28%, respectively 21 and 18% in visual reading are in a comparison of the reading of individual letters and individual words in tactile reading confronted by differences of 41.5, 46, and 61.5% and on an average 49%, and in the reading og interrupted and compact texts by such of 62--82%, on an average 71%. Compare page (24 and 30).

In contrast to this the effects of an impediment in reading which is caused through a separation of syllables are much more alike in both types of writing.

Groups II and IV used for three readings of easier materials:

Reading type	read. material	group	read. time a	read. time b	difference	percent. incr.	percent. sav.	average
a) compact text	learn to fear	II	0.14	0.175	0.035	25%	20%	increase 25 45 50 120:3 = 40%
b) text separated according to syllables	learn to fear	IV	0.11	0.16	0.05	45%	31%	saving: 20 31 33 84:3 = 28%
	the poor and the rich	IV	0.11	0.165	0.055	50%	33%	

In contrast to these results Kutzner's tabloid has the following figures:

KUTZNER'S TABLOID I S. 239

		reading time	
aloud			
line 7	50 words separated by syllables		34.2
line 1	50 words in a compact text	91	22.75
		4	
	difference		11.45
soft			
line 7	50 words of a text separated according to syllables		14.9
line 1	compact	40.7	10.17
		4	
	difference		3.73

50% increase

33% saving

36% increase

25% saving

50 33

36 25

86:2=43/58=29

comparison	increase	saving
tactile	40%	28%
visual	43%	29%

EXPERIMENT B 2

The influence of sense coherence must be recognized best in a confrontation of meaningful and meaningless reading materials. It was pointed out already in experiment A 3 that the reading of the individual sign requires 0.37, respectively 0.33 sec. in a meaningless word and 0.27, respectively 0.25 sec. in a meaningful word. The maningful contents thus saved 37 and 32% of the time.

In experiment B 2 50 one-, two-, three-, four-, anf five syllable words were given a) with meaning and b) without meaning. Altogether 4500 words were read by the 18 subjects of group II and IV. The results are given in the following summary:

	1 syllable a	1 syllable b	2 syllable	3 syllable	4 syllable	5 syllable	
Group II	0.18	0.31	0.18 0.35	0.24 0.39	0.20 0.38	0.24 0.38	
Differ.	0.13 = 72%		0.17 = 94%	0.15 = 62%	0.18 = 90%	0.14 = 58%	376:5 = 71%
Group IV	0.17	0.30	0.18 0.33	0.23 0.32	0.18 0.29	0.20 0.31	
Differ.	0.13 = 76%		0.15 = 83%	0.09 = 40%	0.11 = 61%	0.11 = 55%	315:5 = 63%
Slowest Reader	0.27	0.41	0.30 0.41	0.32 0.39	0.36 0.36	0.37 0.37	
Differ.	0.14 = 53%		0.11 = 36%	0.07 = 22%	0 0	0 0	111:5 = 22%
Fastest reader	0.15	0.26	0.12 0.23	0.15 0.23	0.11 0.24	0.11 0.26	
Differ.	0.11 = 73%		0.11 = 91%	0.08 = 53%	0.13 = 118%	0.15 = 136%	471:5 = 94%

The average reading times per sign are in group II 0.21 sec. with meaningful words and 0.36 sec. with meaningless words and in group IV 0.19 and 0.31 sec. The differences of 0.15 = 71% in group II and of 0.12 sec. = 63% in group IV are without question effected by the content meaning. The great fluctuations in the increases between the five word groups were mostly to be attributed to the extreme use of time of individual subjects in the reading of meaningful words, in other words, to a relatively too small influence of psychic aids that existed in those cases. This phenomenon can be seen best in the difference of 22% which we recorded with the slowest reader; the best reader's 94% stands in violent contrast to this.

The reading times of meaningless combinations pretty much resemble those of the individual letters (experiment A 3). This equality has its basis in the lack of the functioning of the content meaning.

EXPERIMENT B 3

While in the previous readings meaningless words were contrasted with meaningful ones, we will in this experiment contrast meaningful but disconnected words with a meaningful text. For this purpose an easily comprehended material, a paragraph from the fairy tale the"Frogking" , and then a somewhat more difficult treatise on the founding of an international commission for music are read forwardly and backwardly. In the latter reading the words of both materials appear in reversed order, the last word first, that the reading finger has to pass the reading distance of both readings exactly the same way and also has to pass the same number of letters.

While reading in a forward manner the apperceiving aid influences the total text comprehension, in the backward reading, however, only the comprehension of individual words. The backward reading requires an increased amount of reading time:

In group II in Frogking of 0.13 to 0.17 sec. = 30%
In group II in music writing of 0.15 to 0.17 sec. = 13%

In group IV in Frogking of 0.11 to 0.18 sec. = 63%
In group IV in music writing of 0.14 to 0.19 sec. = 36%

It may strike us how much the increase of reading time differs in forward and backward reading according to the increase of difficulty within the text. It increases:

In forward, ordinary reading in group II from 0.13 to 0.15 sec. = 15%
in group IV from 0.11 to 0.14 sec. = 27%
in backward reading
in group II from 0.17 to 0.17 sec. = 0%
in group IV from 0.18 to 0.19 sec. = 5.6%

We recognize clearly how far the influence of the apperceiving aids in reading a text surpasses the influence in the reading of words. If the text gets more difficult text reading approaches more the reading of words in its course and time consumation, in this case the forward reading approaches backward reading.

In visual reading we have similar situations. Kutzner's tabloid I indicates in line two that 200 words require 83 seconds in forward reading and 109.8 sec. in backward reading. The increase is 32%

EXPERIMENT B 4

should give us another picture of the influence of the various degrees of difficulty that are caused by content. Group IV read a paragraph each of:

1. four fairytales that are easily comprehended:
   Frogking
   learning to fear
   the peasant and the golden lump and
   the poor man and the rich man:
2. three treatises of increased difficulty:
   Trip to a little island by Theodor Storm,
   aims and tasks of the society for the care of the blind,
   preface to the founding of an international commission for musical writing;
3. the world picture of the natural scientist by Dr. e. Schneider;
4. chemistry and astronomy: 50 technical expressions.

Group II read the first three numbers of this list.
The increase of the reading times runs parallel to the difficulties caused by the contents. It rises:

Group II	best reader	average	slowest reader
from material 1 to 2	6.6%	14%	18%
" " 2 to 3	1 08 %	99%	17 7%
" " 1 to 3	122 %	127%	228%

Group IV			
from material 1 to 2	25%	21%	17%
" " 2 to 3	100%	107%	115%
" " 3 to 4	20%	20%	21%
" " 1 to 4	200%	204%	205%

We find within the first two reading materials already with moderate increase in text difficulty a considerable rise in reading time. The difficulty of a mental comprehension of the signs will be the same in both reading materials. The apperceiving aids rarer in the second material, and they help less spontaneously and less fast. Since the sensory function does not cause an increase in reading time, it has to be attributed to the higher factors.

The third material leads into an area which is unfamiliar and strange to the readers. There are hardly any points to start out from for the apperceiving aids , since the basic idea and the technical expressions are often completely new to them. Reproductive influences are significant only in as far as the recognition of the covering frame of the language goes. Thus the reading times also show corresponding increases which are founded as well as in a far reaching limitation of psychic components as in a lack of acoustic aids and consequently in an increased compulsion to identify many details.

Even more difficult are circumstances with the fourth material,the technical expressions from chemistry and astronomy. These are unfamiliar to the reader in their sound picture as well as in their meaning.

Assimiliating influences, therefore, are excluded. Reproducing ones can only in the rarest cases be extended upon the recognition of syllables or word forms as for example --alcohol. Besides, even the written picture is unfamiliar. The most difficult sign "y" exists in nearly every word. To this are added many difficult or unfamiliar letter combinations like "ph" and "th" and not at last the large size of the words. The large increase of the reading times, therefore, can in no case be attributed solely to the limitation of acoustic and psychic forces but also has to count the greater difficulty that is given to the sensory function.A mathematical separation of the two influences cannot be accomplished here. The size of the increase in reading time proves what amount of time is needed for reading which rests upon complete identification and succeeding summation of a majority of letters and where all acoustic and psychic aids seem to be extremely limited. Another confirmation of this matter lies in the fact that the increases in the reading times are parallel to those in visual reading, as can be seen in experiment A 2.

EXPERIMENT B 5

In the confrontation of latin and german words that is given in this ex-

periment the influence of acoustic and psychic aids is easily recognized. Familiar sound pictures and reproductive influences are hardly possible in reading the latin words, since none of the subjects knew that much latin. The increase in reading time in contrast to the german words, the written picture of which was nearly equally difficult to mentally comprehend because of a far reaching conformity of the letters, therefore, expresses unmistakably the compulsion that exists to identify details. The average results are in
group IV 0.31 sec. for latin words and 0.19 sec. for german words
group II 0.31 sec. for latin words and 0.18 sec. for german words
differences of 0.12 and 0.13 sec. amount to 63 and 72%.
With the latin words both groups used the same amount of time; both equally had to identify. With the rare german words a difference occurred. Group II had further reaching apperceiving aids at its command and therefore read faster. Both groups got help from acoustic aids which were absent with the latin words.

EXPERIMENT B 6

The following experiment tries to discover the influence of word mutilations with or without sense coherence in order to further confirm the appearance that with increasing influence of the higher factors the significance of the objective facts that are presented to the sensory function declines. In front of three short stories:

The Peasant and the Devil
A Strange Prescription
Lorelei

are put mutilated words which are repeated in the following text in the same manner. The subjects were asked to first recognize the individual words-- those that had not been recognized were not named-- and then to read the text as quick and unhesitatingly as possible.

The results are in the following order:

Number of words put ahead of text,	material	I	26	II	16	III	13	
" " letters in them	"	I	109	II	66	III	64	
" " " missing in them	"	I	60	II	36	III	44	Total
" " indiv, words not recogn. group	II	I	30	II	19	III	-	49
	IV		75		74		79	228
								277
" " words not recogn. in text "	II	I	0	II	0	III	-	0
	IV		2		17		20	39
								39

Six subjects of group II left in both readings 49 individual and no word ruins at all in the text unrecognized. Twelve subjects of group IV did not recognize 228 isolated words and 39 mutilated words in the text. Of altogether 277 mutilated words that were not recognized when isolated only 39 remained unrecogni-

zed when in the text, which is 14%. 86%, accordingly, were recognized through sense coherence. It was much more difficult for the mecanic apprentices, who were else rather skillful in reading, to figure out the mutilated words than it was for those blind who were professional people. The influence of a narrower or broader spreading out of the net of association is unmistakable.

EXPERIMENT B 7

Two other readings in which the mutilations of the text were contrasted in a text that was easy to understand and in one of a more difficult nature had similar purposes like the previous experiments. It was read a paragraph each from:

the fairytale of the millet grain and
the atomical universe (Weltbild) by Dr. E. Schneider.

The paragraph from the fairytale contained 668 letters. In 130 intervals 274 were missing. The atomic universe contained 764 letters; 302 letters were missing in 118 gaps. The letters that were actually presented were chosen in such a way that they contained dominating complexes of the respective word picture. It was purposely avoided to have shorthand signs or signs from the debate system.

The reading could not take place without disturbance and the reading times increased. Group II needed 0.17 sec. for the fairytale and 0.26 sec. for the universe; group IV needed 0.18 sec. for the fairytale and 0.26 for the universe.

The increased difficulty with the material brought about a rise in time consumation of 0.09 sec. = 53% in group II and of 0.08 sec. = 44% in group IV. Although 41% of the letters in the first material were missing, the text was recognized by all subjects clearly and completely. In the second material 39% of the letters were missing. Moreover, it contained some letter complexes like Fes...kei., Anzieh...kr...atomis..., At..theo.., (dominating letter complexes) the complete word form and meaning of which were so unfamiliar to the readers that the assimiliating aids could not set in; a recognition is then impossible and the words had to be announced; after that the recognition of the material could be completed apart from some slight interruptions. Both materials together contained 1432 letters, 567 were missing, which is more than a third of a correct presentation. 14 subjects were reading the materials — 20048 letters went beneath the reading finger, 8064 were missing. This lack caused 143 noticeable interruptions. Thus these two readings show us to what extent dominating complexes suffice for a complete comprehension of material that is easy to understand and of that which is more difficult to comprehend.

EXPERIMENT B 8

It influences the reading speed greatly if the comprehension as the main motive is hindered by a second, subordinate motive such as proof-reading. The endeavour to recognize mistakes forces one to watch all details and this brings about an increase in reading time. The subjects each read a paragraph from:

1. The story of "The cheap dinner",
2. The treatise "Aims and tasks of the society for the care of the blind",
3. Diderot's " A letter about the blind" (in translation)
   a) with the tendency to possibly recognize all existing mistakes the existence of which had been announced,
   b) to try to read very fast without getting disturbed by the mistakes.

This demand could never be completely fulfilled, particularly not by the youthful subjects. The mistakes made an unimpeded course impossible even with b) and the goal to recognize the influence of the compulsion for identification could not fully be reached in this experiment. The reading times rose from a) to b):

1. material	group	II	0.09 to 0.13	differ.	0.04	= 44%
	"	IV	0.135 to 0.187	differ.	0.052	= 38%
2. material	"	II	0.107 to 0.157	differ.	0.05	= 46%
	"	IV	0.148 to 0.218	differ.	0.07	= 47%
3. material	"	II	0.125 to 0.163	differ.	0.038	= 30%
	"	IV	0.136 to 0.163	differ.	0.027	= 20%
						225:6 = 37.5%

The compulsion to watch details brings about a 37.5% increase in reading time But we must not forget that this calculation was done under conditions a) and b) the latter of which could not either take its course without disturbance. Thus the reading times achieved under a) are confronted with those that were achieved in experiment B 4 under ordinary reading conditions.
We do not get any differences worth mentioning with group II. With group IV the following results were recorded:

I	material:	0.115 to 0.187 = 0.072	= 62%
II	"	0.140 to 0.218 = 0.78	= 55%
III	"	0.115 to 0.163 = 0.048	= 41%
			158:3 = 52%

The average rises to 52% and speaks for the amount of time needed for a many sided identification and also for the amount of time saving which the ordinary procedures achieve in a confrontation even in the process of touch reading.

The number and kind of mistakes that were recognized or overread as well as their position in a word can bring light into degree of the compulsion for identification. Previous experiments were mainly done to determine the time and kept account of only the total number of mistakes. In these three stories one had placed 54 mistakes. The materials were each read 18 times and the total number of mistakes that were hit was 972.204 of them were overread = 21%. This number would have been considerably bigger if the subjects had not been adjust-

ed to recognize mistakes and if the mistakes had been scattered more widely in a larger text.

But in the experiments done with group III more attention was paid to the kind and position of mistakes and the reading times were not measured. In the first reading the writing contained six letters in a reversed form, "e" instead of "i", "d" instead of "f" for example, and six other written mistakes. Ten subjects were reading and altogether 60 reversals and 60 other mistakes were touched by the reading finger. It was overread:

47 reversals = 78% and
25 other mist.= 41%

In a second reading each 6 mistakes were woven into the first and third syllable and 8 mistakes in the second syllable.21 subjects were reading and each 126 mistakes were touched in the first and third syllable and 168 in the second one. The subjects were not told that the materials contained mistakes in order to have at least in the beginning conditions like in the ordinary course of the reading process. It was overread in the

first syllable 17 mistakes = 13.4%
second syllable 69 mist. = 41%
third syllable 78 mistakes = 61.9%

We clearly recognize from these percentages that far greater attention is paid at the word beginning to the distinct recognition of the characters and that this endeavour is reduced in the middle of the word and even more in the end of the word when the reproductive influences start operating. But even in this case it was not possible to preserve the conditions of ordinary reading in their purest state for any length of time; for as soon as the first mistakes had been recognized a vivid tendency started to find further mistakes.

EXPERIMENT B 9

Professor Dr. Kutzner gives some interesting examples in which the influence of the momentary state of mind upon the reading shows up umistakably in touch reading. Thus after a long reading in French the respective subjects can think of only French words although only German ones had been exposed. In a second case after a reading about Jesuits they read "Klosterhut" (cloister living) instead of "Kindheit"(childhood), and after a visit at the theatre "Zuschauerraum" (place where the audience is sitting) instead of "Zimmermann"(carpenter). Such striking influences can hardly appear in our experiments with touch reading because they are not tachistoscopical in kind and because it is not possible to artificially produce directly before reading constellations of the mind that

can impression the mind to such a degree. But despite this we are left to examine whether thoughts or images present in the mind at the moment of reading can exercise such a strong influence upon the reading that words or parts of words are read that deviate from the objective data and correspond more to the constellation of the mind than to the objective factual material.

For this purpose reading materials were chosen that made such changes possible with the frequently occurring words or in those words where these changes could be expected on account of the text's content. Thus it happened that it was read "Wandermensch" instead of "Wandersmann" in the third repetition of Hebbel's Spazierritt, that it was read "rechts und lind" instead of "rechts und links", and "Beide" instead of "Beine". In the story of the Hausgenossen by Reinick it was read "Kehlkopf" instead of "Kohltopf" in the third repetition and in the fifth one "Kohltopf", "Baum, Bum" instead of Baum, Baum, "umfellen" istead of "umfallen", "weiht" instead of "weint". (Words that have a meaning in themselves but that make no sense in the respective content).After a disscussion about proverbs a number of them were presented to the subjects, nine of which were given incorrectly among three times that many that were correct. In a series of words,mostly city names, well known suffixes appeared 3-4 times correctly and once with a hardly noticeable mistake in the writing. The first question in this experiment again concerned the reading times. They were in Spazierritt(the ride)
in group II 0.122 sec. and in IV 0.156 sec.
with Hausgenossen(members of the household) in group II 0.162 and in IV 0.163 sec.
with proverbs in IV 0.160 sec.
with the suffixes in IV 0.260 sec.

In contrast with the materials that had the same degree of difficulty of the content but which were given in the correct form , the reading times again increase considerably as can be seen from the following examples:

group II took in exp. B 8 0.09 sec. for the 1. material and 0.122 sec. for Spazierritt
group II took in exp. B 8 0.107 sec. for the 2. material and 0.162 sec. for the Hausgenossen
group IV took in exp. B 4 0.115 sec. for the 1. material and 0.156 sec. for Spazierritt
group IV took in exp. B 4 0.140 sec. for the 2. material and 0.163 sec. for the Hausgenossen

This means increases from 35 and 51% in group II, average 43%
and 35 and 16% in group IV, on an average 25.5%.

The reason for this increase can only lie in the fact that the comprehension of the meaning of the text could not be the sole factor of the psychic activity but that it was influenced by secondary tendencies.

Secondly, we are interested in the number of incorrect readings. It was overread from the reversals:

In Spazierritt by group II 44%, in IV 40%
IN Hausgenossen by group II 42.5%, in IV 52%
In proverbs in IV 12%
In suffixes 21%

The mistakes in the first two readings which are around 50% indicate in how many cases the influence of vivid expectation may out do the one of the objective facts in reading.

The percentage of incorrect readings would have been considerably larger in the first two readings if the conditions of ordinary reading could have been observed better throughout the reading. But upon the recognition of the first (rather amusing appearing) reversal a danger signal was given and the subjects were led accordingly.

EXPERIMENT B 10

In proceeding from the idea that the comprehension of the characters(signs) in the reading process is only releasing in kind and that the retranslation of the traditional signs into thoughts are psychic acts the question arises as to the evaluation of the meaning which is conveyed by the individual signs. As in visual reading the individual letters meet to form an individual word configuration or to combine to dominating complexes and consequently promote the releasing of the psychic acts and also accelerate it, similar combining carriers of meaning could become significant also in touch reading. For this particular purpose the extension and the care of the shorthand writing and the debate writing for the blind may very well of great value. If, for example, one letter stands for a whole word in this writing, the advantage which the form quality produces in visual reading is pretty far caught up with for this word in touchreading, since in both cases only the act of comprehension becomes necessary ; however, it is supposed that the reader masters this type of writing exceptionally well and that the psychic operation with the sensory elements takes place as easy as in visual reading. Through the promotion of the shortening writing types tactile reading must get much closer ro visual reading in its procedures and accomplishments. Skillful shorthand readers will state that the reading of shorthand is easier than that of the complete braille and that above all it takes place more pleasantly. They distinctly feel the great saving in psycho-physical energy.

In comparing the extents of the accomplishments in the different kinds of braille writing we encounter difficulties in the variety of subjective attitudes in the subjects and their skill that carry in certain doubts into the results of the reading experiments, particularly if the subjects are of different ages, have a different education, and have different occupations. Our list of the results will also show this variety.

Group III used 1368 seconds in the first reading in ordinary braille and 1140 sec. for the second reading of the same material in the short form. The difference of 228 sec. means a saving of 16.5%. But the picture changes when the reading sequence is inverted: In a second paragraph of the same material the shorthand uses an extra 17% of time. The first named saving thus is founded far more in a repetition of the same material than in a change of the type of writing. This statement is further confirmed by two other experimental results: in reading further paragraphs of the same material a second timein the same kind of writing the shorthand had a saving of 32.5% in the repetition and ordinary braille of 21%.

In the readings done by group II and IV the second reading, as was said before, was done one week later. Group II used in "Frogking", starting with the ordinary braille, 630 and 508 sec. and had a saving of 122 sec. = 19%. In the "Halligfahrt" the reading order was inverted and the saving was only 98 sec. =8.5% Group IV read "Halligfahrt" , likewise in shorthand first. One subject had a saving of 35 sec. = 21%, another of 12 sec. = 7.2%, a third one of 18 sec. = 7.2%, and still another one of 15 sec. = 6.3%; the savings amounted to 5, 4.3, 3, and 1.7%. The average was 6.8%. An extra use of time was not needed in any case.

In order to establish a maximum of time saving through the short form, ten subjects of group II and IV were used for the following examination: two paragraphs of the story "Meister Linke" by Karl Keller had been transferred into ordinary braille and into the short form. Each paragraph numbered 1679 characters in our ordinary writing; the first one numbered 1664 in ordinary braille and 1071 in the short form, the second 1646 and 1052 signs. Five subjects read the first paragraph in ordinary braille , the second one in the short form and the five others chose the reversed order. In scoring individually we get the following results:

Braille	Short Form	Difference	Saving
170 sec.	150 sec.	20 sec.	11.7%
210	160	50	23.8%
180	138	42	23.3%
210	180	30	14.2%
234	184	50	21.3%
160	150	10	6.2%
152	140	12	8 %
175	150	25	14.2%
148	125	23	15.5%
150	128	22	14.6%
			Total: 152.8%
			average saving 15.2%

Thie list shows us that a higher percentage of saving is not always found with the fastest reader. The total saving of 15.2% can under the conditions used here

put to credit to the short form without any doubts.

The thought that the short form shortens just those components of the reading process which gives specific difficulties to the blind readers and thus catches up on the advantages that the visual readers have, at least partly, offers the blind reader an incitement to completely master this type of writing. That the short form makes far greater savings in space and time possible is mentioned here only on the side. This saving was with the material of group III

1036--742 = 294 = 28% in letter spaces
822--531 = 291 = 35% in characters

and in the two paragraphs of the story "Meister Linke"

1664-- = 593 = 35%, 1646--1052 = 594 = 36%

The advantages that lie in the use of shorthand should according to our theoretical assumptions be even surpassed by those of the debate writing. It is still difficult today to give proofs out of the practice. For that this kind of writing in its official form has not yet been enough used. Blind shorthand typists read self-written dictations during their office work in which the normal form of shorthand appears in an individual fashion that corresponds to the respective occupational branches. Only very few reading materials in this kind of writing of a universally interesting content. Therefore, readers who possess enough skill in standard stenography are still so scarce that it is still impossible to make comparisons of the use of time within larger or even smaller groups.

EXPERIMENT B 11

15 particularly advantageous results that did not go beyond 0.08 sec. per character were taken from the total of our experiments for a comparison of the reading speed in tactile and visual reading. Two subjects of group II participate with 5 results and five subjects of group IV with 10 results. The figures go from 0.04 sec. up to 0.08 sec. and are on an average 0.069 sec. This constitutes the average of many visual readers of this group in reading aloud.

In a second comparison the material from experiment B 10 "Meister Linke" was read by six seeing subjects and the results were compared with those of six blind readers. The reading times were in

visual reading		ordin. braille	shorthand braille
First Part	Second Part		
135 sec.	135 sec.	160 sec.	138 sec.
130 "	120 "	180 "	150 "
95 "	90 "	152 "	140 "
132 "	130 "	175 "	150 "
118 "	120 "	148 "	125 "
130 "	132 "	150 "	128 "
740:6 = 123	727:6 = 121	956:6 = 160	831:6 = 138 sec.

Average 122 sec.

Average values for one paragraph are in:
visual reading 122 seconds
shorthand braille 138 sec.
ordinary braille 160 sec.

In contrast with visual reading shorthand reading still demands an extra of 16 seconds = 13% and ordinary braille an extra of 38 sec. = 31%.

The following individual results are of special interest:

One blind subject surpassed the average result of the visual readers by 3 seconds = 2.4%.

A second subject surpassed the average by 6 seconds = 5%. These two subjects stayed in their use of time behind of four visual readers, thus, only two visual readers read faster. The two slowest tactile readers surpassed the slowest visual reader by 11%.

The tactile reader stays considerably further behind, opposite such successes in tactile text reading, the visual reader in the reading of individual letters and of disconnected words, as was indicated already earlier. But in order to have this comparison conducted with the same subjects, the subjects who participated in experiment 11 read still 50 words with three, four, five, and six letters each; their average reading times were 26.1, 31, 38.6, and 44.6 sec. Kutzner's tabloid I gives in the lines 21—24 ~~us~~ the figures for the reading times for nouns with three, four, five, and six letters as : 24.4, 24.7, 25.4, and 29.1. The tactile reader surpass these reading times in the four groups by: 7, 25, 51, and 53%, on an average 34%.

These results provide us with the proof that only the higher compenents can be the ones that let the tactile reader approach the visual reader so closely in their readings.

STATEMENTS OF THE SUBJECTS

Observations about a touch reading process are not frequent in the area of psychological experimentation. Statements that come from blind readers about this process, therefore, should be of special interest. The already mentioned statement made by one 18 year old subject:

"I always only attended to the meaning of what I read and never paid any attention to the procedure of the reading act" lets us already see that the gains from such statements cannot be large ones. From group II we get the following statements:

"I am forced to feel every letter that I want to read. In an easy text I read only the beginnings of words in this way and I supplement everything else."

"I do not line letters together. Im able to catch a short word picture beneath my fingers which appears to me primary as a totality. I overread smaller mistakes."

"Reading is something else than a lining together of letters. Mental influences

lead to a faster comprehension of the content."

In group IV we have two types of readers. The one reads very carefully, does not overlook mistakes, and needs an increased amount of time. The other uses far less time, but he makes extensive use of the acoustic and psychic aids. From him come the following declarations:

"I grasp a word at one time by sliding across the letters. Often I recognize only individual letters and guess the rest."

"I recognize words of just one syllable without beeing conscious of the individual letters. Often I read only one part of the word and supplement the missing part."

"I often have the word before me before my fingers have passed all letters. In strange words I have to spell them out."

In these statements it is clearly shown that the compulsion to identify all details is not universal in tactile reading, that the inclination towards a spelling kind of reading seems to be small, and rather a vivid effort is made to make use of the acoustic and psychic aids as much as possible.

SUMMARY OF EXPERIMENTAL RESULTS

A 1 undertakes to determine position and size of the reading area and discovers that all regions of the finger tip are of equal value in the acceptance of tactile sensations, except for the place which lies directly before the finnail.

A 2 emphasizes in a comparison of visual reading of braille and of ordinary writing the specific difficulty of the first one. This difficulty is expressed in an additional 33--183% of time used.

A 3 tests the recognition of various letter forms in the reading of individual signs and words. In loud reading the differences are between 35--64%, in soft reading they are between 16--39%.

A 4 establishes the shortest span of time in which individual letters and word complexes can be recognized through touch; such span of time would be from 0.04--0.08 seconds.

B 1 compares the amount of time that is used in the reading of texts that are either compact or interupted by intervals between the individual letters. It is found that the reading of a compact text saves 71% of the time that is needed in the reading of the interrupted text. A comparison with the results of A 3 indicates that the letters from an interrupted text still have a time saving of 32% in contrast to isolated, individual letters.

B 2 examines the influence of the sense coherence of a word and finds that this influence achieves time savings of 63 and 71%.

B 3 compares the influence of sense coherence in the reading of texts and of meaningful individual words and gets differences of 13--63%.

B 4 examines the influence of different degrees of difficulty caused by the content and discovers that an increase in the reading times is proportional to it. The increases run between 6 and 228%.

B 5 compiles an equal number of latin and german words with possibly the same amount of letters and discovers that the first ones require an additional 63 and 72% of reading time, a fact, which can be explained only through a lack of acoustic and psychic aids.

B 6 recognizes the large influence of sense relationship from the large number of mutilated words that were not recognized when isolated(277), but that were recognized in a text (228). The difference was86%.

B 7 shows to what extent dominating complexes suffice despite a lack of about 40% of the letters for a comprehension of a text.

B 8 shows the use of time it takes in a compulsion to pay attention to the details in a word . It calls for increases of 20--46%.

B 9 examines the influence of of the momentary frame of mind upon the reading process.

B 10 Compares the reading speed that it takes in the various types of braille writing. The short form can achieve time savings of 6.2--21%, on an average 15.2%.

B 11 compares the speed of touch reading to that of visual reading and discovers that in the reading of a text the short form approaches visual reading pretty much in regard to its speed. In the reading of individual things, however, it stays further behind. Individual tactile reader are able to outdo with the short form visual readers in speed.

The total of experiments fully confirms the statement made at the beginning that the processes of tactile and visual reading do not just become alike in their final goal, but that they meet already in the course of the reading act. They run quite proportional even if partly on different numerical levels.The same components are responsible for the succeeding, the effects and the success of the higher components are alike in kind. Differences can be only of gradual nature. The accomplishment in tactile reading varies individually, but can be build up higher through excercise.

This statement contains an encouragement for everybody who does not possess the power of seeing or who is threatend by the loss of his eyesight; for they are guaranteed here the possibility of a complete, unreserved participation in the intellectual and cultural life of their seeing fellow men.

Finally, I gladly fulfill the honourable duty to express my heartfelt gratitude to Professor Dr. Kutzner, who already in 1923 suggested that I do this work and who gave me many advices during its accomplishment. My gratitude includes as well Director Dr. Kremer, the collueges of the school for the blind, all blind ladies and gentlemen and also the students at the school of the blind who put themselves as subjects at my disposal or supported me in the accomplishment of the experiments.

Dueren, April 1951.

Hubert Horbach

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Horbach, H. Tactile Reading

A series of experiments modeled after those of Vernal reading in which it is the author's intention to show that tactual reading occurs as a result of the gesamtform (total form) of the word. The work is divided into 2 parts:

A) the sensory function
B) the effect of the higher components.

Subjects: 1) 6 sighted faculty members at the School for the Blind at Overen
2) 6 blind persons at Overen
3) 12 students at Overen from the yr. 1933
4) " " " " " " " 1950

A 1) Three levers & different sized weights & Braille char. were presented to subjects of group 3 at exposures of $\frac{1}{35}$ – $\frac{1}{5}$ of a second. Also ink was placed on the tips & fingers of the subjects to determine differential sensitivity of the fingers tips.

Results: correct identifications rose from 40% at 1/35 sec to 90% at $\frac{1}{5}$ sec.
Little difference in % correct identifications according to region of finger used, except immediately below fingernail which was quite inaccurate.

TACTUAL SYMBOL LEARNING STUDY (1962)

Name ..... Sex ..... Age.....

School..... Grade..... Date..... Test Day .....

I
oscar
alpha
romeo
victor
poppa
echo
x-ray
tango
foxtrot

II
foxtrot
echo
tango
alpha
oscar
poppa
romeo
victor
x-ray

III
foxtrot
poppa
echo
tango
oscar
romeo
victor
x-ray
alpha

IV
oscar
tango
poppa
alpha
echo
victor
x-ray
foxtrot
romeo

V
echo
alpha
oscar
x-ray
tango
poppa
romeo
foxtrot
victor

VI
alpha
poppa
victor
foxtrot
romeo
oscar
tango
x-ray
echo

VII
romeo
poppa
oscar
echo
victor
tango
alpha
foxtrot
x-ray

VIII
echo
foxtrot
victor
oscar
romeo
tango
x-ray
alpha
poppa

IX
foxtrot
poppa
romeo
tango
x-ray
victor
echo
oscar
alpha

X
alpha
echo
poppa
x-ray
romeo
oscar
tango
victor
foxtrot

A2) Group I subjects usually read 3 types of material, increasing in difficulty, in printed & braille form. Same material in both forms.

Results: From print to Braille, reading time increased from 143% to 183% for material increasing in difficulty.

Reading time for print on the basis of difficulty of subject increased from 41% – 150%, & for braille from 56 – 191%.

A3) Lists of letters, meaningful & meaningless words composed of 1) 10 basic forms, 2) Burkler's most legible, & (3) least legible characters were presented to Group II & IV subjects. Reading times recorded.

Results: Both groups of subjects read meaningful words in each class in a shorter period of time than the letters. The meaningless words were intermediate.

A4) Group IV was presented lines of characters of the following types at four exposure times – I, II, III, IV (in order of shortest to longest.

A) characters with upper tenths (B) Burkler's most legible
C) Burkler's least legible (D) 2 most legible
E) 2 more difficult (F) 2 particular difficult

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poppa
romeo
victor
x-ray

III
foxtrot
poppa
echo
tango
oscar
romeo
victor
x-ray
alpha

IV
oscar
tango
poppa
alpha
echo
victor
x-ray
foxtrot
romeo

V
echo
alpha
oscar
x-ray
tango
poppa
romeo
foxtrot
victor

VI
alpha
poppa
victor
foxtrot
romeo
oscar
tango
x-ray
echo

VII
romeo
poppa
oscar
echo
victor
tango
alpha
foxtrot
x-ray

VIII
echo
foxtrot
victor
oscar
romeo
tango
x-ray
alpha
poppa

IX
foxtrot
poppa
romeo
tango
x-ray
victor
echo
oscar
alpha

X
alpha
echo
poppa
x-ray
romeo
oscar
tango
victor
foxtrot

G) familiar syllables of 3 letters.

Results: The # of subjects correctly identifying the characters at each exposure time:

Exposure Times	Stimulus Types A	B	C	D	E	F	G
I	6	9	3	0	1	2	1
II	6	3	5	5	5	2	4
III			4	1	2	1	5
IV				4	4	4	0
V				2	0	3	2

The foregoing results are interpreted as a substantiation of the importance of the form quality of the words or syllables.

B. The Higher Components

To determine the effect thru comparison of reading times of such variables as familiarity, sense coherence, difficulty of content, etc.

In experiment A 3 different types of responses were required of the lists of letters, + words. The types of responses were a) reading letters aloud, and (c) as short-hand signs (?), and (b) in a soft voice, and (d) meaningful words, and (e) meaningless words aloud. The reading times are further analysed here to evaluate the question if +

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romeo
victor
x-ray
alpha

IV
oscar
tango
poppa
alpha
echo
victor
x-ray
foxtrot
romeo

V
echo
alpha
oscar
x-ray
tango
poppa
romeo
foxtrot
victor

VI
alpha
poppa
victor
foxtrot
romeo
oscar
tango
x-ray
echo

VII
romeo
poppa
oscar
echo
victor
tango
alpha
foxtrot
x-ray

VIII
echo
foxtrot
victor
oscar
romeo
tango
x-ray
alpha
poppa

IX
foxtrot
poppa
romeo
tango
x-ray
victor
echo
oscar
alpha

X
alpha
echo
poppa
x-ray
romeo
oscar
tango
victor
foxtrot

how far individual signs have to be identified in tactile reading."

Results: 1) Meaningful words were read ~~at a~~ in 41.5% less time than letters.

2) a 25% savings was realized in reading the letters softly. (a repetition; unreliable)

3) a 22% savings was found between reading meaningful words & letters in soft voice.

The above findings were credited to the aid of the higher components.

Note: ~~It~~ should also be noted that the meaningless words were read in 25% less time than the letters. There seems to be no reason for this unless there were timing errors or space between the letters (not mentioned by author, but assume as much) which were not in meaningless words. Moreover, the author states the responses to the letters in a soft voice are unreliable but repeatedly uses these measures to further demonstrate the effect of the higher centers.

~~ther is the~~
~~see then none.~~
~~f the comparisons~~
~~ns be considered~~
~~valid.~~

The above results were interpreted as "sure proof that a universal identification of the letter forms does not either take place in tactile word or text reading."

TACTUAL SYMBOL LEARNING STUDY (1962)

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foxtrot
poppa
echo
tango
oscar
romeo
victor
x-ray
alpha

IV
oscar
tango
poppa
alpha
echo
victor
x-ray
foxtrot
romeo

V
echo
alpha
oscar
x-ray
tango
poppa
romeo
foxtrot
victor

VI
alpha
poppa
victor
foxtrot
romeo
oscar
tango
x-ray
echo

VII
romeo
poppa
oscar
echo
victor
tango
alpha
foxtrot
x-ray

VIII
echo
foxtrot
victor
oscar
romeo
tango
x-ray
alpha
poppa

IX
foxtrot
poppa
romeo
tango
x-ray
victor
echo
oscar
alpha

X
alpha
echo
poppa
x-ray
romeo
oscar
tango
victor
foxtrot

B 1) Groups II, III + IV read materials embossed in (a) compact form + (b) with a separation between characters (interrupted form)

Results: All materials show an average of 71% savings in time favoring compact texts.

Interpreted as an indication of the effect of sense coherence or content.

Note: Groups not matched; same material read in both form by 2 groups. Reading order not specified.

B 2) Groups II + IV were presented with 50 1, 2, 3, 4, + 5 syllable meaningful + meaningless words.

Results: Meaningful words read in 67% less time than meaningless groups of syl.

Interpretation: Another indication of content meaning or sense coherence.

B 3) Groups II + IV read 2 stories, one more difficult than the other, forward + backward (order of words reversed).

Results: The backward readings required 46 + 34% more time for the easier + more difficult material, respectively.

43. boil " #

44. bubble " #

45. firefly " #

46. cave " #

47. sleigh " #

48. velvet " #

49. road " #

50. ink " #

51. shadow " #

52. window " #

53. jewel " #

54. bridge " #

55. cloud " #

56. air " #

57. bus " #

58. steeple " #

59. star " #

Interpretation: The influence of apperceiving aids emanating from text.

Note: ~~Ex~~ Order of presentation of material not specified.

B 4) Tests content difficulty with 4 types of material read by groups II + IV.

Results: Finds reading time increases proportionally with difficulty of material.

B 5) Examines influence of acoustic + psychic aids by presenting groups II + IV with Latin + German words.

Results: Reading ~~time for~~ of Latin words required 67 % more time than German.

B 6) The effect of sense coherence on the detection of errors is examined by placing an ~~#~~ equal # of the same mutilated words both before + within 3 test passages. Groups II + IV read the materials.

Results: They don't make sense, but supposedly 277 mutilated words were not recognized prior to the beginning of the text, while only 39 were left unrecognized within the body of the text.

Attributed to sense coherence.

17. dim " #

18. prayer " #

19. nap " #

20. hill " #

21. island " #

22. sparkle " #

23. color " #

24. brass " #

25. tiger " #

26. scarlet " #

27. flame " #

28. tune " #

29. rainbow " #

30. picture " #

31. butterfly " #

32. flash " #

33. giraffe " #

34. snowflake " #

35. heat " #

36. missle " #

37. dream " #

38. city " #

39. flag " #

40. voice " #

41. robin " #

42. ship " #

B 7) Groups II + IV read an easy + efficient passage in which certain letters were removed (supposedly) leaving the dominating complex.

Results: No figures; but states the easy text was read clearly + completely, while the hard text was read with more difficulty....

The reading time for both texts was longer than usual.

B 8) Groups II + IV read 3 texts arranged with mistakes under the conditions: (a) finding as many mistakes as possible + (b) reading the material as fast as possible, disregarding the mistakes.

Results: between conditions a + b reading time rose only 30 – 40 %

Note: Again, the order in which the mistakes were found was not specified.

Exclusive position of mistakes was noted + it was found mistakes were overread in the first syl. only 13.4 %, 2nd syl – 41 %, + 3rd " 61.9 %.

B 9) Examined misreadings of text brought about by momentary frame of mind. Rescued proverbs + then presented same to groups II + IV to read.

Found mistakes overread.

1962 WORD ASSOCIATION TEST

Name _____ Sex _____ Date _____ Birthdate _____

School _____ Grade _____ Visual Group _____ Age _____ mos.

Samples:

A. chair " #

B. sheep " #

C. thief " #

D. scissors " #

E. salt " #

1. thunder " #

2. lake " #

3. lamp " #

4. rhyme " #

5. meadow " #

6. chimney " #

7. frost " #

8. ant " #

9. web " #

10. ocean " #

11. windmill " #

12. sweet " #

13. stripe " #

14. hidden " #

15. train " #

16. forest " #

B 10) Compared reading speed of material in ordinary form & short form.

Shows cognizance of sequence effect & uses 2 paragraphs & 2 groups of 5 subjects each (However, subjects not matched).

Found average saving of 15.2 % in favor of short form.

B 11) Contrasts visual reading & Braille with tactile reading of ordinary form & short hand form. Used material from B 10 above. Does not say if visual readers read the short-hand form.

Found visual reading fastest, short form approaching visual. Fastest short form readers did better than slowest visual readers

Interprets all the results as confirming his supposition of the sameness of the process of tactile & visual reading.

43. boil " #

44. bubble " #

45. firefly " #

46. cave " #

47. sleigh " #

48. velvet " #

49. road " #

50. ink " #

51. shadow " #

52. window " #

53. jewel " #

54. bridge " #

55. cloud " #

56. air " #

57. bus " #

58. steeple " #

59. star " #

1) Amount of time required to recognise char's & the sensitivity of different parts of the reading finger.
2) Comparison of visual & tactile reading of Braille material increasing in difficulty.
3) Differences in recognition time of letters, & meaningful & meaningless words.
4) Comparison of reading different types of letters & letter combinations at varying exposure times.

1) To what extent individual signs have to be recognized in word recognition.
3) The effect of word coherence or context, and meaningfulness
3) " " of appercieving aids or text meaningfulness
4) Content difficulty
5) Acoustic & psychic aids
6) Dominating complexes
7) Intention + momentary frame of mind
8) Syllabic importance
9) effect of contractions
10)

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9. web " #

10. ocean " #

11. windmill " #

12. sweet " #

13. stripe " #

14. hidden " #

15. train " #

16. forest " #

1/18/2013
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